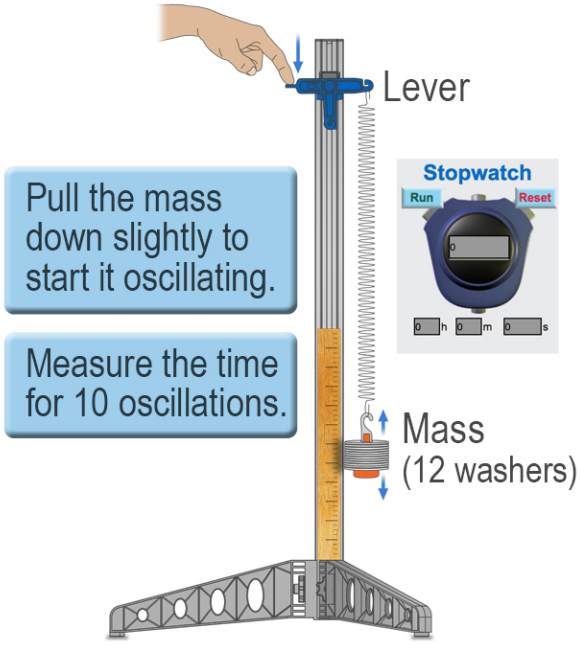
Investigation 14C: Resonance

Essential Question: What is resonance?

When *periodic forces* are applied to a system that can oscillate, the resulting motion can vary tremendously. If the frequency of the force matches a natural frequency of the system, a *very* large amplitude response can occur. The extra-large response is what we call *resonance.*

Part 1: Finding the natural frequency

1. Mount the lever to the top of the stand.
2. Hang the stiff spring from the lever arm, and then hang the mass (12 washers) from the spring.
3. Attach a ruler to the stand centered on the hanging mass.
4. Pull the mass down slightly to start it oscillating.
5. Measure the time for ten oscillations.



Questions

a. What is meant by the oscillator's "natural frequency"?

b. What are the values of your oscillator's natural period and frequency?

Table 1: Measured frequency and period

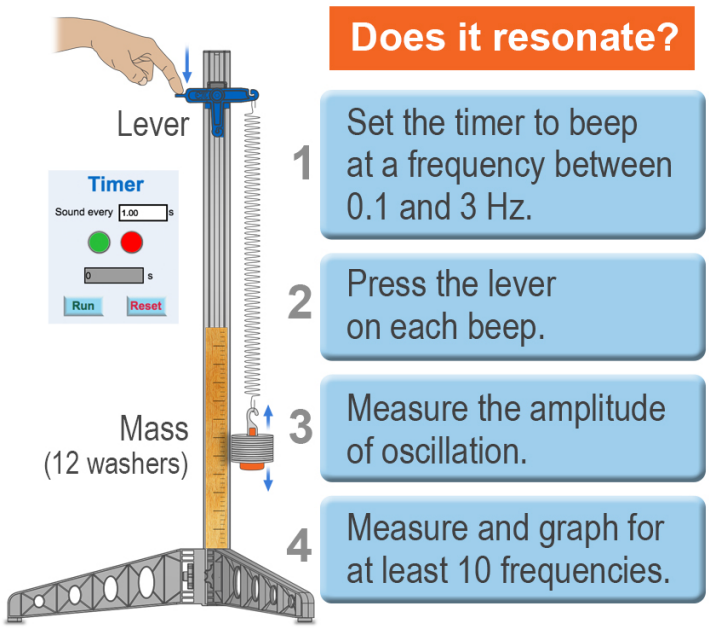
	Trials					
	1	2	3	4	5	average
frequency						
period						

c. Describe and then apply a method to estimate the error bars on your frequency measurement.

d. Describe the meaning of the terms *phase* and *amplitude*.

Part 2: Creating resonance

1. Set the timer to beep at a frequency of between 0.1 and 3 Hz. (Convert between frequency and period first!)
2. While using one hand to hold the top of the stand in place, use your other hand to press down on the lever on each beep.
3. Have your partner estimate the amplitude of the motion using the ruler.
4. Measure and tabulate the oscillation amplitude for at least ten frequencies ranging between 0.1 Hz and three times the natural frequency. One measurement should be at the frequency you measured in Part 1.
5. Graph the oscillation amplitude versus the frequency of the periodic force.



Questions

a. In your own words, define resonance by referring to the motion you just observed and the graph of your data.

b. At what frequencies is the oscillator in resonance? At what frequencies is it out of resonance?

c. Describe the flow and storage of energy in the system at resonance compared to frequencies that are not at resonance.

d. Prepare a written report for your investigation (parts 1 and 2). In addition to addressing the above questions, describe the procedure, results, and conclusion (or interpretation) of your investigation.

Table 2: Amplitude as a function of frequency

Frequency (Hz)	Period (s)	Amplitude (cm)